V. Monitoring and Assessment

This section discusses the county's ongoing monitoring and watershed assessment program in water quality and stream quality (physical assessment and bioassessment) as well as the roles of the Northern Virginia Soil and Water Conservation District and the Audubon Naturalist Society.

Runoff is a significant cause of erosion in county streams.

Runoff carries pollutants, including trash, to county streams.

Dry Weather Screening Program

A total of 280 sites were screened for illicit connections and improper discharges to the MS4 during 2004, using a combination of grab samples, optical brighteners, and automated hurly sampling. Fairfax County's Dry Weather Screening program has been a part of the VPDES permit for the past eight years. The goal of the program is to continue ongoing efforts to detect the presence of illicit connections and improper discharges to the MS4. During 2004 extensive field screening efforts were again carried out in the Accotink Creek Watershed as a result of proactive implementation of a TMDL, which was developed for fecal coliform impairment for portions of Accotink Creek. SWPD's staff worked with the USGS in screening outfalls. There were 220 sites sampled during two sampling events, optical brightener monitoring was performed at 60 locations, and hourly sampling (via automated samplers) was performed at six stations.

Wet Weather Screening Program

The goal of the program is to investigate and address known areas within the county that are contributing excessive levels of pollutants to the MS4. In 2004, using the data collected as part of the Industrial and High Risk Runoff program, nine potential sites were identified for possible wet weather screening. Some of these sites will be sampled in 2005. A map showing the nine locations is in ***Appendix K***.

A GIS-based screening procedure for identifying potential "hot-spots," based primarily on intensity of land-use (imperviousness and land-use type) is part of the long term goals and will be used to rank and prioritize potential sites for field screening.

Industrial and High Risk Runoff Program

The goal of the county's program is to identify and possibly investigate and monitor industrial and other high-risk areas to determine if they are contributing substantial pollutant loading to the MS4. Possible areas include: landfills; other treatment, storage, or disposal facilities; hazardous waste treatment, storage, disposal, and recovery facilities; facilities subject to the Emergency Planning and Community Right-To-Know Act (EPCRA) Title III, Section 313.

During 2004, nine sites from the DEQ list of VPDES permitted stormwater industrial facilities that discharge into the Fairfax County MS4 were selected for potential wet weather monitoring, some of which will be sampled in 2005. This list will be expanded in future years by coordination with the county's Fire and Rescue Department's (FRD) Hazardous Materials and Investigative Service (HMIS) and the County's Division of Solid Waste Disposal. The complete list is in ***Appendix L***.

Watershed Monitoring Program

The permit requires the development of a long-term Watershed Monitoring Program to verify the effectiveness and adequacy of stormwater management controls and identify areas of water quality improvement or degradation.

The county's goals for the program are: 1) Evaluate the effectiveness of regional versus on-site stormwater management practices; 2) Obtain data for the development, calibration, and verification of water quality simulation models; and 3) Determine whether differences in pollutant concentrations from various residential land-uses (low, medium, and high density) are statistically significant.

A paired watershed approach is being used to meet these goals. The paired watershed approach entails the comparison of water quality data from two or more watersheds with different levels of imperviousness. Potential locations (at a subwatershed scale, approximately 0.8 square miles) for water quality monitoring have been identified by using available GIS information as part of the county's integrated monitoring design. Subwatersheds with current land uses that were (1) predominantly low density residential, and (2) predominantly medium to high density residential, were identified. These subwatersheds have been evaluated using GIS layers (orthophotography, street, streams and stormwater, and storm sewer inventory) to determine locations for field investigation.

During 2004, field investigations of the potential sites were conducted. One of the most important aspects was site access, not only for installation/construction, but for maintenance, placement and recovery of the automated sampling equipment and collection of water samples. Two sites were selected and water sampling hardware was mounted in the outfall. Permanent housing structures with locks were installed next to the outlet for the Isco sampler and the rain gauge.

Water Quality Monitoring

Two sites, one draining a high-density residential area, and the other a low-density residential area, were monitored in 2004 during the same rainfall event. The water quality and rainfall data are summarized in ***Appendix M***. The data suggest the event mean concentrations (EMCs) for many constituents are significantly greater for the high-density residential site compared to the low-density residential site. While total nitrogen (TN), total kjeldahl nitrogen (TKN), and total dissolved solids (TDS) concentrations were similar at both sites, total suspended solids (TSS) and total phosphorous (TP) concentrations were

two to two and a half times greater at the high density urban site. Additionally, fecal strep and *E. coli* concentrations were seven to ten times higher at the high density urban site. When compared to the five-year median (1997 to 2001) EMCs for most of the constituents are comparable except for TSS and TP, which are considerably higher in the 2004 sample. One possible explanation for this is that the sampler intake location my have resulted in bedload sampling. This will be further evaluated after the next round of sampling results is available. At the current time there is insufficient data to allow statistical analysis of the differences in constituent EMCs from the two sites or computation of loadings from the sites. Monitoring will continue in 2005 and the data used for statistical analysis of differences in constituent EMCs from the sites as well as the development of continuous water quality models that provide more refined prediction of water quality loadings. This will allow more meaningful evaluation of alternative stormwater management strategies.

Automated sampling equipment was used to collect stormwater for water quality monitoring. Collection was triggered by preset rainfall amount and stream stage. The rain gauges, designed to National Weather Service specification, operate by a tipping bucket mechanism capable of measuring rainfall at 0.01-inch intervals. Sampling equipment consists of the following equipment; Isco 6700 automatic sampler, Isco 730 bubble flow module, Isco Pal 1101 pH and temperature monitors, and American Sigma rain gauge. To reporting data from the Isco 6700 automatic sampler and Pal 1101 pH monitor, data loggers use Isco FlowLink4 and Isco Samplink software programs, respectively. The Isco FlowLink4 data reports (program settings report, combined results rain and flow reports, and the data tables for flow and rainfall) correspond to the American Sigma Streamline data reports provided in year one of the permit. In addition, the FlowLink4 reports include hourly summary reports and graphs (plotted using five-minute data intervals) for rain and flow. The Isco Pal pH monitor will measure pH during the entire monitoring period; readings are recorded every fifteen minutes and whenever a sample is collected. For quality control, flow depth calibrations and flow depth measurement checks, along with rain gauge precipitation checks, will be conducted during each station set up.

Wet weather sampling equipment:
Isco automatic sampler with bubble flow module and pH and temperature monitors; and American Sigma tipping bucket rain gauge.

Bacteria Monitoring Program

The first full year that the Stormwater Planning Division (SWPD) has taken over bacteria monitoring from the Health Department was concluded in 2004. The 84 original sampling sites were sectioned into nine separate zones and two of those zones were sampled twice a month, for a total of over 300 bacteria samples. In response to the EPA recommendation to use concentrations of *E. coli* rather than concentrations of fecal coliform to determine possible health issues, the concentration of *E. coli* was determined in addition to fecal coliform starting in May of 2004. Bacteria sampling involved using whirl packs to take grab samples from the stream to determine the concentration of fecal coliform and *E. coli* in the water. In addition to the assessment of bacteria, sterile bottles were used to collect samples to determine NO_3 and PO_4 as a secondary test for possible human inputs. Finally, chemical parameters, such

as pH, water temperature, dissolved oxygen, and specific conductance, were taken at the time of bacteria sampling using a combination of YSI 85 or YSI 556 and Accument Portable pH meters. The sampling techniques, the sample site locations, the parameters sampled, as well as the chemical data collected for each site is the same as the previous Health Department monitoring program. More information will be available in the SWPD Comprehensive Monitoring Report, which will be completed in spring of 2005.

Bioassessment and Integrated Water Quality Monitoring Program

In 2004 a probabilistic site selection sampling methodology was implemented to allow statistically defensible inferences on a countywide basis. A stratified random site selection methodology was chosen to achieve this goal. Stratification was based on the Strahler stream order and randomly selected from all county waterways from first to fifth order (rivers and lakes excluded). Sites were also chosen to proportionally represent the distribution of stream orders throughout the county network, and also with respect to physiographic province. Therefore, the majority of sites were selected from first order streams, while the higher order streams had proportionally fewer sample sites (relative to their representative abundance). Likewise, a proportionally representative number of samples were randomly chosen from the three physiographic provinces that the county lies in. In 2004, 30 sites were sampled in Fairfax County, along with the 11 Piedmont reference sites in Prince William Forest National Park. Two additional Coastal Plain reference sites (located in the county) were also sampled. All sites were sampled for benthic macroinvertebrates, while second- through fifth-order sites were also sampled for fish. First order sites were excluded from fish sampling because of their relatively low abundance of fish.

Other ongoing 2004 Stream Protection Strategy (SPS) program activities included:

- Conducting a quality assurance/quality control (QA/QC) survey on the perennial stream field data and updating/correcting the Fairfax County Chesapeake Bay Preservation Area maps (adopted in 2003) with any necessary changes (for final submittal in spring 2005).

- Collaborating with George Mason University in an USEPA jointly funded assessment of wetlands within Fairfax County, with a special emphasis on their relative degree of correspondence with National Wetland Inventory (NWI) maps and analysis of similarity between urban BMPs and natural wetlands.

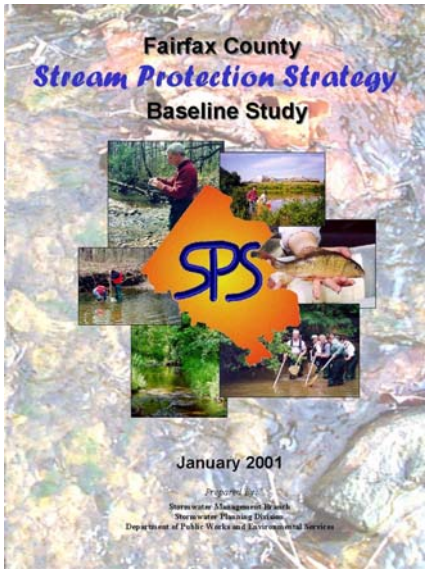
- Assisting U.S. Geologic Survey staff in sample collection and discharge assessment in an ongoing fecal coliform source tracking study within the Accotink Creek watershed related to the bacterial TMDL.

- Cooperation with citizen groups such as Audubon Naturalist Society and the Northern Virginia Soil and Water Conservation District in training and educating citizens in volunteer stream monitoring and the subsequent incorporation of this data into the county database of stream assessments.

The SPS program is an ongoing assessment of the ecological integrity of major streams and tributaries within the 30 watersheds in Fairfax County. The initial phase of this study commenced in September 1998, and a program of annual field monitoring was instituted in the spring of 1999. An original baseline study was conducted in 1999 to evaluate the physical, chemical, and biological conditions of freshwater streams countywide. Modified versions of the EPA's Rapid Bioassessment Protocol (RBP III) were employed along with a QA/QC methodology at 114 sample sites within the county and also at 11 additional biological reference sites in the Prince William Forest National Park. Fish and Benthic

macroinvertebrate communities were sampled along with instream and riparian habitat assessments, chemical (water quality) parameters, channel morphology, and land use/impervious cover assessments. The results from the original baseline assessment (completed in 2000) were used to identify, rank, and prioritize county streams, and broad management categories and strategies were subsequently developed for future restoration and/or preservation efforts on a sub-watershed basis. Major recommendations from the study included:

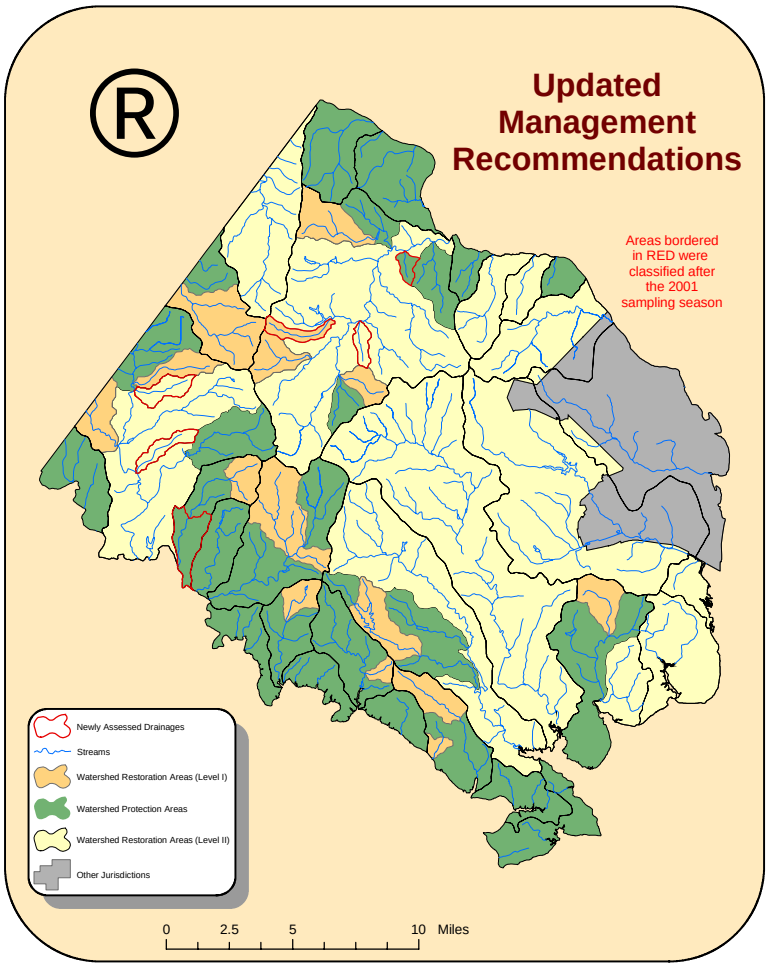
- A continued 5-year rotational sampling scheme for the county's streams
- The need for a complete countywide stream physical assessment survey to be conducted on ALL streams
- Ultimately, the development and implementation of watershed management plans
- The pursuit of a dedicated source of funding for implementing the proposed improvements in county streams and the stormwater infrastructure system
- Encouraged use of Best Management Practice (BMP) and Low Impact Development (LID) techniques in all new construction and retrofit activities



The baseline data is being used as part of a long-term database as well as to guide future management activities, especially as they relate to the development and implementation of Watershed Management Plans. Publication of the baseline report occurred in January, 2001, and the entire document was subsequently made available to the public on the county's Web site:

http://www.fairfaxcounty.gov/dpwes/environmental/sps_main

The countywide sub-watershed management categories were further refined and updated in 2001 (see figure below).



Floatable Monitoring Program

The county is an active participant in Virginia Department of Conservation and Recreation's (DCR) Adopt-A-Stream program. The Watershed Planning and Assessment Branch of DPWES has adopted a 1.5 mile section of stream in the headwaters of Difficult Run, which they have been cleaning up since the fall of 1999.

During 2003 and 2004 the program expanded to include the determination of the quantity of floatables collected by the numerous clean-up groups within the county. A list of the DCR sponsored Adopt-A-Stream organizations in Fairfax County was obtained from DCR, a survey questionnaire was developed, and contact was made with thirteen organizations to collect the following information: organization name and contact; stream name and location; clean-up dates; and quantity and description of floatables collected. This information was put into a database. The floatables study is presented in ***Appendix N***.

Each of the thirteen organizations has adopted a single stream reach within Fairfax County. Stream reaches where clean-up activities are occurring include: Accotink Creek, Cedar Run, Daniels Run, Difficult Run, Tributary of Difficult Run, Dogue Creek/Pikes Creek, Holmes Run, Little Rocky Run,

Pimmit Run, Pohick Creek, Saucy Branch, Shenandoah River, Snakeden Branch, and unnamed perennial streams.

The dominant type of trash found was bottles and cans; next was trash bags, toys, and tires. The average number of bags of trash and the total number of bags increased from 1999 to 2002. In 2002, the total amount of trash decreased while the average number of bags per cleanup event remained relatively constant.

Respondents were asked to identify the most unusual item they found, which included: a Frisbee, deer skull, silt fence, bike, gas mask, beaver skull, golf ball, shovel, car transmission, La-Z-Boy recliner with electric cord, Metrobus sign, empty asphalt containers, civil war cannon ball, apartment advertisement sign, plastic drainage pipe, plastic edging material, muffler, decking material, toilet, motorcycle frame, sofa bed frame, handcart, carpet, street sign, water heater, turkey baster, toothbrush, rusted out car parts, tricycle, truck tailgate, tennis racket, 100 pounds of concrete, wheel barrow, wedding pictures, computer monitor, Ab-roller, partial kayak, baby shoe, and a hub cap.

Accotink Creek Total Maximum Daily Load

In 1998, a 4.5 mile segment of Accotink Creek in Fairfax County, beginning at the confluence of Crook Branch and Accotink Creek to the start of Lake Accotink was placed on the Virginia 303(d) Total Maximum Daily Load (TMDL) priority list for fecal coliform impairment. As a result of this, Fairfax County Health Department entered into a partnership with the United States Geological Survey (USGS), the Virginia Department of Conservation and Recreation (DCR), and Virginia Department of Environmental Quality (DEQ) to pursue a bacteria source tracking study for Accotink Creek as part of a statewide study. The initial study results indicated that the sources of bacteria are distributed as follows; 40% waterfowl, 20% human, 13% dogs, 5.4% raccoon, 1.4% deer, and 21% other.

The final two of eight planned synoptic sampling events were performed during 2004. The first event was completed the week of February 17–20 with a total of 109 samples collected. The second synoptic sampling event was performed Sept 12–15 with a total of 115 samples collected. As part of the September sampling event, optical brightener monitoring was performed at approximately 60 stations, and hourly sampling (via automated samplers) was performed at six stations. This hourly sampling was done to document any short-term variability in the water quality at these stations. Lastly, more intensive storm drain sampling was performed at four storm drains to better understand how elevated fecal coliform concentrations were occurring at the storm drain outfalls. To achieve this goal, samples were collected from the storm drain outfall and a number of other sites that were located further up-gradient into the branched network of each storm drain outfall. Bacteria Source Tracking (BST) and organic tracers were used selectively during campaigns three through seven.

Samples collected exceed the 400 col/100 mL water quality standard 36 percent of the time. A multi-agency team consisting of Stormwater, Wastewater, and Building Code Enforcement personnel was utilized to investigate the storm sewer network, sanitary lines, and buildings near outfalls that were consistently elevated with fecal coliform bacteria and/or other tracers. One such investigation took place at Site T13, where an overflow was repaired. The boron, surfactants, and fecal coliform data collected at this site were at remarkably lower levels after the repair was completed. A preliminary list of “hot spots” has been identified for future investigation in 2005.

The U.S. Geological Survey will be preparing a report summarizing the findings and providing recommendations on the most effective tracers for identifying human sources of fecal coliform bacteria.

County staff plans to use the results and lessons learned from this study to help investigate and address areas with elevated fecal coliform bacteria based on hot spots identified as part of the countywide bacteria monitoring program.

The USGS has published a paper specifically on their project in the Accotink Creek watershed of Fairfax County. This report outlines the techniques and methods used in the study and development of the fecal coliform TMDL for Accotink Creek. It can be viewed and downloaded from the Web at:

http://water.usgs.gov/pubs/wri/wri034160/wrir03-4160.htm

Kingstowne Environmental Monitoring Program

The goal of the Kingstowne Environmental Monitoring Program is to provide information to protect Huntley Meadows Park from the detrimental effects of upstream development occurring in Dogue Creek watershed. Of particular concern are excessive sediment loads, which can place too much silt in the natural stream channels and potentially smother wetland vegetation. Excessive sediment loads could also increase the suspended sediment concentrations to levels that are harmful to aquatic life. Construction upstream of the monitoring point is minimal and erosion and sedimentation controls, including stormwater BMPs, are minimizing sediment loads to Dogue Creek. Phosphorous loads are not meeting the U.S. Army Corps of Engineers' requirements and almost half the BMP ponds need maintenance. The county and the Corps are currently evaluating the problem and determining the course of action.

The original monitoring program consisted of a single station upstream of Telegraph Road (know as the Kingstowne station). During the summer of 2002 a new monitoring station (known as South Van Dorn, or SVD) was established on Dogue Creek downstream of the existing Kingstowne station in order to comply with a U.S. Army Corps of Engineers permit issued for the construction of South Van Dorn Street, Phase III. This new station is intended to evaluate the implementation of the Dogue Creek Watershed Stormwater Control Plan. This plan resulted in the construction of a number of stormwater management facilities, which were designed to achieve a 50 percent total phosphorus removal rate from stormwater discharges in the watershed. A 10-year monitoring and maintenance plan are to be implemented in order to confirm compliance with this permit condition. The new station is located adjacent to Telegraph Road and monitors drainage from a watershed area of 1,148 acres (the 845 acres monitored by the Kingstowne station, plus an additional 303 acres).

A total of eighteen baseflow water quality samples were collected at the Kingstowne station and South Van Dorn during the July 2003–June 2004 monitoring period. Baseflow sampling provides a good indication of background levels of pollutants and may provide information regarding chronic water quality problems. The data will also serve as a basis for long-term water quality trend analysis. Since grab samples were taken on a monthly-to-biweekly basis, these data provide a "snapshot" of water quality conditions rather than a continuous record. The Kingstowne Annual Report is presented in ***Appendix O***.

Northern Virginia Soil and Water Conservation District Volunteer Stream Monitoring Program

Across Fairfax County, Northern Virginia Soil and Water Conservation District's (NVSWCD) trained volunteers assess the ecological health of streams. This Volunteer Stream Monitoring Program provides training, equipment, support, data processing, and quality control (See program overview, ***Appendix P***). Monitoring includes biological and chemical aspects and a habitat assessment. Volunteers are trained to

assess ecological conditions in streams based on the diversity and composition of benthic macroinvertebrates (stream insects). They conduct biological monitoring following the modified Save Our Streams Protocol. Volunteers also conduct chemical analyses of turbidity and nitrate/nitrite and make physical observations. Training includes indoor and field workshops and mentoring by experienced monitors. Volunteers commit to monitoring their chosen stream four times a year or assist other monitors at their sites. Sites are located throughout the county and in the City of Fairfax. Certified data is forwarded to Fairfax County, Department of Environmental Quality, Virginia Save Our Streams, and other interested organizations or individuals. In addition to learning about stream monitoring, many volunteers also become involved in watershed groups, clean-up programs, and educational programs. NVSWCD works with many organizations to coordinate and lead additional watershed-based learning opportunities for citizens and students to help them become better environmental stewards. NVSWCD also provides guidance for science projects and internships.

NVSWCD's Volunteer Stream Monitoring Program supplements the county program and provides other services to the environmental community in Fairfax County. In addition to providing monitoring data, NVSWCD provides training sessions for monitors, conducts special programs at schools, makes presentations at environmental conferences and for civic associations, sponsors tours, hosts a list serve, and publishes a newsletter. Many programs are enhanced by partnerships with other groups in the county government and private environmental organizations. NVSWCD staff assists a variety of citizen watershed groups by providing administrative and technical support. These groups include: Difficult Run Community Conservancy, Friends of Little Rocky Run, Fairfax Trails and Streams, Friends of Cub Run, and Friends of Sugarland Run.

In 2004, NVSWCD led 54 stream monitoring training sessions or watershed programs, with over 150,000 participants (note: The same person can attend multiple programs and therefore is counted multiple times. The number accounts for each attendee not for different individuals). Watershed programs include: indoor stream ecology programs at schools, presentations to civic groups, table displays at environmental programs, tours of water and sewage treatment plants, watershed walks, and stream clean-ups.

The numbers of active monitors is steadily increasing. In 2004, there were 53 active sites. There were 100 monitors who collected winter data, 138 monitors who collected spring data, 165 monitors who collected summer data, and 174 monitors who collected fall data. Approximately 225 students were introduced to stream monitoring through indoor workshops at schools, outdoor special programs, and science fair projects. During 2003, volunteers logged over 3705 Earth Team hours. The Earth Team is a national program of the Natural Resources Conservation Service and tracks volunteer time.

The Northern Virginia Soil and Water Conservation District sponsored teams from James Madison High School, Thomas Jefferson School for Science and Technology, and Hidden Pond Nature Center in the Virginia Envirothon, a natural resources competition for high school students. Participants learn about stewardship and management concepts and work to solve real and hypothetical environmental problems. The program is field-oriented and gives students an opportunity to work with natural resource professionals in the areas of aquatics, forestry, soils, and wildlife.

Newsletters and calendars are sent to about 700 people and forwarded to hundreds more, a very effective way to reach large numbers of existing and potential monitors. Several newsletters are available for downloading from the monitoring websites. The monitoring Web addresses are below:

http://www.fairfaxcounty.gov/nvswcd/monitoring.htm

http://mason.gmu.edu/~jcornell/StreamMonitoring/index.html

In 2004, partners included: George Mason University's New Century College, Arlington County's Environmental Services Department, Reston Association, Stormwater Planning Division—Department of Environmental Services and Public Works, Lake Accotink Park—Upper Accotink Creek Watershed Education Program, Riverbend Park, National Park Service—George Washington Memorial Parkway, Alexandria Seaport Foundation, Eleanor C. Lawrence Park, George Mason University's Hemlock Overlook Center for Outdoor Education, and Hidden Oaks Nature Center. The Stream Monitoring Program worked with the following schools: Woodson High School, Lee High School, G.C. Marshall High School, Fairfax High School, T.C. Williams High School, Robinson High School, Westfields High School, Daniels Run Elementary School, Thomas Jefferson School for Science and Technology, and Green Hedges School. In 2004, NVSWCD continued its strong partnership with GMU's New Century College, introducing over 150 college students to monitoring and involving them in stream restoration and clean-up projects.

NVSWCD continues to distribute *A Volunteer Partnership, Working with Citizens to Improve our Streams.* The brochure was developed by DPWES and NVSWCD to inform citizens about the Stream Protection Strategy study and ways they can become involved through steam monitoring and Adopt-a-Stream programs.

Audubon Naturalist Society

The Audubon Naturalist Society (ANS) water quality monitoring program recruits, trains, equips, and organizes volunteers to assess the health of streams throughout the Washington, D.C., region. The program uses a modified version of the EPA's Rapid Bioassessment Protocols (RBP) to perform habitat assessments and benthic macroinvertebrate surveys. All monitoring equipment is provided to the volunteers. There are six permanent ANS sites within Fairfax County that are covered by 20 to 30 volunteers each year. The data collected by ANS are currently shared with DEQ for 305 (b) listings, Prince William County DPWES, National Park Service, and Dept of Game & Inland Fisheries.

Volunteers assess habitat conditions and macroinvertebrate community composition (usually to family level) at specific points throughout the year (May, July, and September, with an optional winter sample). Macroinvertebrates are collected using a "hand-scrubbing" sampling technique, and collected individuals are visually identified to the family taxonomic level where possible. Multiple samples are collected from riffle and pool areas.

Monitors gauge overall habitat condition by visually assessing parameters such as substrate composition, embeddedness, turbidity, bank cover, and canopy cover. Four other components of the EPA's RBP habitat assessment—channel flow status, bank stability, sediment deposition and riparian zone width—are also scored. Readings of pH and water temperature are taken concurrently.